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NRL Memorandum Report 1427

FRACTOGRAPHY

PART XI

EXAMINATION OF A

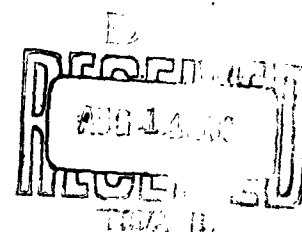
7075 T-6 ALUMINUM ALLOY FORGING FRACTURE

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METALLURGY DIVISION

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U. S. NAVAL RESEARCH LABORATORY
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CONTENTS

Abstract	11
Problem Status	11
Authorization	11
INTRODUCTION	1
OBSERVATIONS	1
CONCLUSIONS	2
ACKNOWLEDGMENT	2
REFERENCES	2

ABSTRACT

An intergranular fracture mode was observed by electron microscopy in the crack initiation region of the subject failure indicating that the fracture resulted from stress corrosion cracking. No evidence of mechanical fatigue crack propagation was observed.

PROBLEM STATUS

This is an interim report; work on this problem is continuing.

AUTHORIZATION

NRL Problem Number M01-08

Bureau Problem Number RRMA 02 091/652 1/ROO7 06 01

INTRODUCTION

A section containing the fracture origin from the lower orifice support tube of a F101 main landing gear assembly which failed during the final stages of a laboratory fatigue test program was submitted to the Metallurgy Division for electron microscope fractographic analysis. The part which failed was made from a 7075 T-6 aluminum alloy forging. A portion of the fractured section, Figure 1, shows the fracture initiation region, light area, and the fast fracture propagation region, dark area. Two-stage plastic palladium-shadowed carbon replicas were prepared for electron microscope observations of the fracture topography of both regions.

OBSERVATIONS

A representative area from the fracture initiation region is shown in Figure 2. The faceted or "rock candy" appearance indicates that the crack propagated along grain or sub-grain boundaries in an intergranular fracture mode. Figure 3 shows the micro-appearance of a representative region in the fast fracture area. The network of small dimples is typical of overload fracture in this aluminum alloy. The dimples result from small voids which tear open in the fracture plane and are thought to be associated with small precipitate particles. No evidence of mechanical fatigue crack propagation was observed

in either area. Such fatigue markings, having been observed on fractures of 7075 T-6 alloys (1) (see Figure 4) subjected to severe conditions of "after the fact" handling and corrosion, would presumably have been observable if the subject failure had resulted from mechanical fatigue.

Figure 5 shows a mounted and polished cross-section of a portion of the fracture in the crack initiation region. The stepped fracture profile was generally parallel to the elongated grains and secondary cracks were observed near second phase particles strung out in this direction by the forging operation

CONCLUSIONS

The intergranular fracture mode, the stepped appearance of the fracture profile, and the absence of evidence of mechanical fatigue in the fracture initiation area indicates that the failure in this region resulted from a stress corrosion cracking mechanism. Final fracture of the forging took place when the stress corrosion crack penetrated to a sufficient depth to cause the remaining material to fail through mechanical overload.

ACKNOWLEDGMENT

The fracture replicas were prepared by Mr. J. E. Flint. His skillful and careful work is greatly appreciated.

REFERENCES

1. Brown, B. F. and Edwards, A. J., "Fractography. Part VII. Examination of Fractures in Dive Brake Outer Skins from Model A35 Aircraft", NRL Memo Report 1360, October 1962



Fig. 1 - Macroscopic view of a section from the fracture in the landing gear forging showing the initiation region, light area (arrow), and the fast crack propagation region, dark area. Magnification 5.5X.



Fig. 2 - Intergranular fracture in the crack initiation region.
Magnification 6,000X.



Fig. 3 - Dimpled rupture surface in the fast fracture region.
Magnification 6,000X.

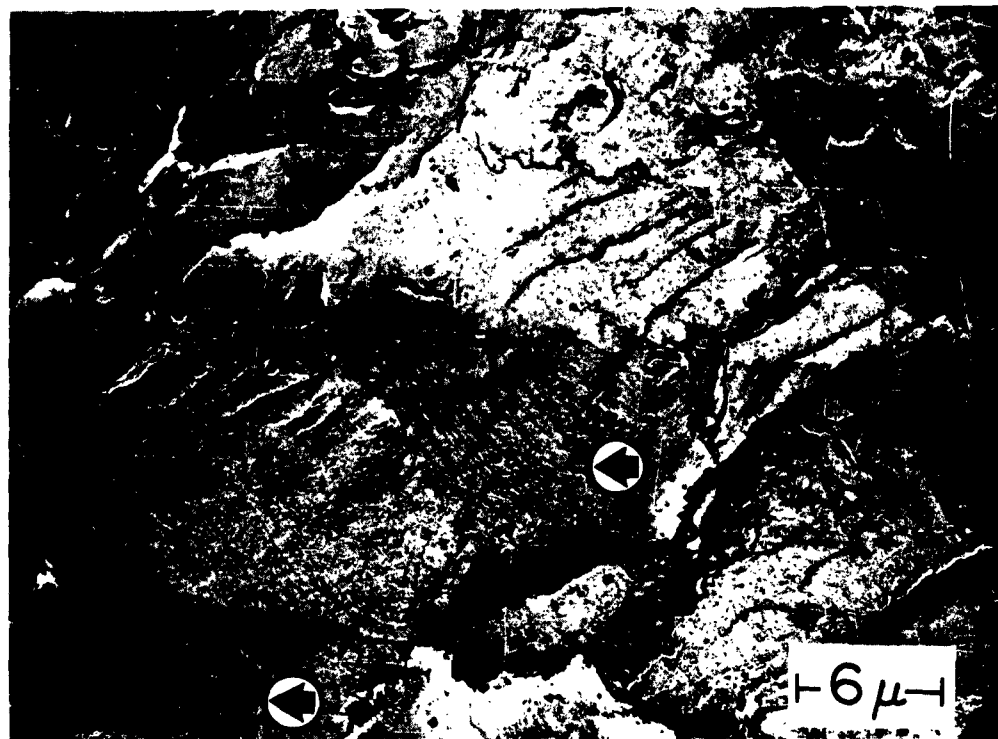


Fig. 4 - Fatigue fracture markings (arrows) on a 7075 T-6 aluminum alloy dive brake skin. Magnification 2,000X.



Fig. 5 - Cross section of the subject failure showing the fracture profile in the crack initiation region. Magnification 200X.

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